O Level Combined Chemistry Structured

Periodic Table Test 2.0

Q1

(a) Four elements, **P**, **Q**, **R** and **S** are found in the same period of the Periodic Table. The information about these four elements are given below:

Element **P** forms a covalent compound with chemical formula P_2O.

Element **Q** is ductile and malleable, and is a solid at room temperature.

Element **R** reacts explosively with water to form an alkaline solution.

Element **S** exists as an inert gas and is used in vacuum-tubes.

(i) State **one** similarity of the electronic structures of these four elements.

.....

.....[1]

(ii) Arrange these elements in order of increasing atomic number.

.....[1]

(iii) Suggest how element R can be extracted from its compounds.

.....[1]

(b) Table 4.1 shows some physical properties of the Group VII elements.

Table 4.1

halogen	melting point / °C	boiling point / °C	colour
fluorine	− 220	− 188	pale yellow
chlorine	− 101	− 35	
bromine	− 7	59	reddish-brown
iodine	114	184	grey-black

(i) Complete Table 4.1 by filling in the colour of chlorine. [1]

(ii) Using the information in Table 4.1, describe the arrangement and movement of bromine at room temperature.

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.....[2]

Q2

(a) Three Group I metals of the same mass were simultaneously added to water in beakers X, Y and Z. Fig. 11.1 shows the bubbles of gas produced as the reaction took place.

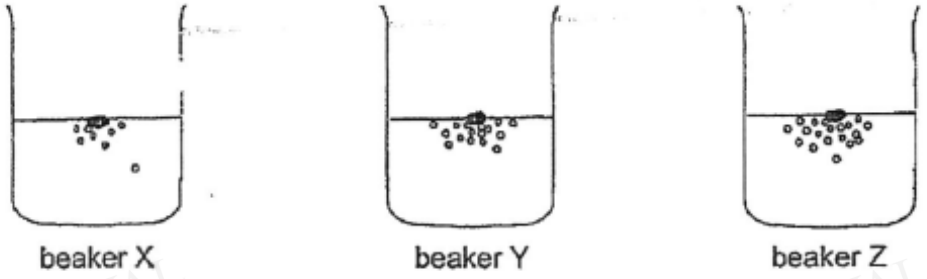

Fig.11.1

(i) Given that potassium was added to beaker Z, identify the metal added to beaker X.

..... [1]

(ii) Describe a test to identify the gas produced during the reaction. State the expected observation.

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..... [2]

(iii) Before the metals were added, a few drops of Universal Indicator were added to the beakers of water.

State the colour change, if any, that would be observed in the three beakers as the Group I metals react with water.

.....

..... [1]

(iv) In a fourth beaker, copper of the same mass was added to water and a few drops of Universal Indicator were added.

Describe two differences that would be observed compared to the other three beakers.

1 .....

.....

2 .....

..... [2]

(b) Chlorine, bromine and iodine are found in Group VII of the Periodic Table.

(i) State two similarities in the physical properties of chlorine, bromine and iodine.

1 .....

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2 .....

..... [2]

(ii) Describe and explain the observation, if any, when chlorine gas is bubbled through potassium iodide solution.

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.....[2]

[Total: 10]

Q3

8 Use the Periodic Table provided to answer the following question.

(a) Explain, using sodium as an example, what you understand by the terms 'group' and 'period'. [2]

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(b) Lithium, sodium and potassium are elements found in Group I of the Period Table. [5]

Describe how water can be used to show a trend in the reactivity of these elements. Write a balanced chemical equation, with state symbols, for one of the reactions.

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(c) When sodium burns in chlorine, sodium chloride is formed. [3]

Use the ideas of electron sharing and electron transfer to explain why sodium chloride exists as the ions Na^+Cl^- rather than the covalent molecule Na-Cl.

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Q4

(a) Use your knowledge of electronic structures to explain the following statements.

(i) Elements in Group II all have similar chemical properties.

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..... [1]

(ii) Elements from Group VI act as non-metals.

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..... [1]

(iii) Elements from Group 0 lack chemical reactivity.

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..... [1]

(b) Element Z with an atomic number of 85 is so unstable that it has never been seen by the naked human eye.

(i) Suggest two ways in which chlorine differs in properties from element Z.

1. .....

2. ..... [2]

(ii) Draw a 'dot-and-cross' diagram to show the structure of an ion of Z.
You only need to show the outer shell electrons.

[1]

(iii) Excess chlorine is bubbled through a solution containing ions of Z.

Write an ionic equation for the reaction involving chlorine and the solution containing ions of Z. State symbols are not required.

..... [2]

Q5

This question is about Group VII elements.

(a) The element with an atomic number of 85 is so unstable that it has never been seen by the naked human eye.

Consider the properties of other elements in the same group as this element. Predict **one physical** property and **one chemical** property of this element with an atomic number of 85.

Write a balanced chemical equation to represent the chemical property that you have described.

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.....[3]

Answers

Periodic Table Test 2.0

Q1

1(a)(i)	They all have the **same number of electron shells.**	[1]
(a)(ii)	R, Q, P, S	[1]
(iii)	It can be extracted using **electrolysis**.	[1]
(b)(i)	greenish-yellow / yellow	[1]
(ii)	At room temperature, bromine is a liquid, thus, it has a **disorderly arrangement** and is less closely packed than in the solid. Particles can **slide over one another over a short distance**	[1] [1]

Q2

(a)(i)	Lithium;	[1]
(a)(ii)	Insert a lighted splint to a sample of the gas evolved; Light splint/flame will be extinguished with a 'pop' sound;	[1] [1]
(a)(iii)	Green solution will turn blue/purple;	[1]
(a)(iv)	It will sink to the bottom of the beaker; No bubbles will be observed/ effervescence not produced; Green solution remains green/ no change in colour of universal indicator; No visible change/ no change observed; Any 2, max 2m A: copper will not extinguish the lighted splint with a 'pop' sound R: no reaction/ no colour change (only)/ wrong spelling effervescence/ no flame produced	[1] [1] [1]
(b)(i)	Coloured/ produce coloured gas when heated; Low melting point and/or boiling point; Do not conduct electricity/ heat OR poor heat/ electrical conductors; Low densities; Any 2, max 2m R: diatomic molecules	[1] [1] [1]
(b)(ii)	Colourless solution turns brown; Chlorine is more reactive than iodine, thus it displaces iodine from potassium iodide to form iodine solution;	[1] [1]

Q3

(a)	Elements can be arranged in Groups based on their number of valence electrons. They can also be arranged in periods based on their number of electrons shells. Sodium is in Group I since it has only 1 valence electron and is in Period 3 as it has 3 electron shells. [1m for explaining 'group' and 'period'] [1m for using sodium as example]	[2]
(b)	Place a small piece of each element separately into a trough of water. Lithium will float on the water surface and melt away. Sodium will darts on the water surface and catches fire. Potassium will darts more rapidly on the water surface, catches fire and explodes. The reactions of three elements in water show that lithium is the least reactive while potassium is the most reactive among the three. elements. $2Li\ (s) + 2H_2O\ (l) \rightarrow 2LiOH\ (aq) + H_2\ (g)$ $2Na\ (s) + 2H_2O\ (l) \rightarrow 2NaOH\ (aq) + H_2\ (g)$ $2K\ (s) + 2H_2O\ (l) \rightarrow 2KOH\ (aq) + H_2\ (g)$ [2m for describing reactions of all 3 metals in water correctly; 1m for describing reaction of at least 1 metal in water correctly] [1m for stating reactivity trend] [2m for correct equation; 1m for all correct formulae + 1m for correct balancing & ss (award only when all formulae are correct)]	[5]
(c)	Sodium has the electronic configuration 2.8.1. Chlorine has the electronic configuration 2.8.7. When sodium chloride is formed, each sodium atom transfers 1 electron to a chlorine atom. This result in the formation of Na^+ and Cl^- ions which have stable electronic configurations. Sharing of electrons between a sodium atom and chlorine atom will not enable the atoms to achieve a stable electronic configuration. Hence sodium chloride does not exist as a covalent molecule. [1m for stating e.c. of Na and Cl] [1m for explaining how Na+ and Cl- are formed] [1m for explaining why NaCl is not covalent]	[3]

Q4

(a) (i) All the elements in Group II have the same number of valence electrons, which are responsible for chemical reactions, hence they have similar chemical properties. [1]

(ii) Elements in Group VI have 6 valence electrons, hence they have a tendency to gain 2 electrons to form negative ion of charge 2-, acting as non-metals. [1]

(iii) Elements in Group O have full electron shells, hence does not need to lose or gain or share electrons.

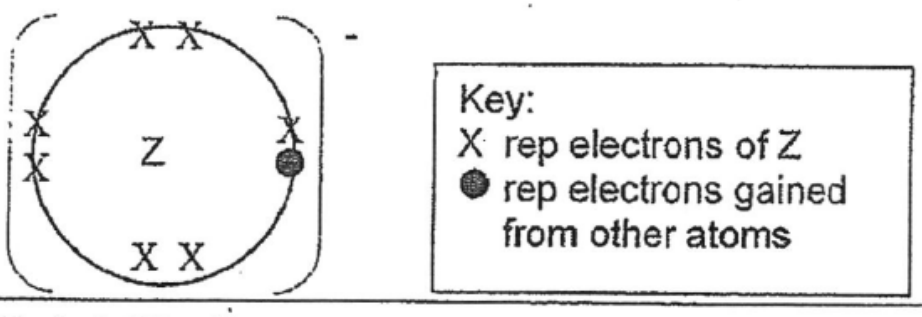
Accepted: 'fully filled electron shells' – Pease inform students to use 'full electron shells' in future.
Reject: if 'share electrons' is missing.
Reject: 'transfer' in place of 'lose or gain' [1]

(b) (i)

Chlorine	Element **Z**
1. yellowish green gas at rtp	1. black solid at rtp
2. more reactive	2. less reactive
3. lower mp & bp	3. higher mp & bp
4. lower colour intensity	4. higher colour intensity

Must show comparison between chlorine and element Z.
[1] for each comparison, max [2] [1]

(ii) Dot-and-cross of ion Z



[1]

(iii) $Cl_2 + 2\,Z^- \rightarrow 2\,Cl^- + Z_2$

Chemical formula – 1m ; balanced equation – 1m [1]

Q5

Element is Astatine (At).

Physical property:

- Black solid at room temperature [1]
  (Also accept: Highest melting/boiling point in Group VII)

Chemical property:

- Least reactive halogen in Group VII; *or*
- its halide ions can be displaced by any other halogen in Group VII [1]

Chemical equation [1]

$2\ NaAt + I_2 \rightarrow 2\ NaI + At_2$

(also accept KAt; any other halogen molecule: F_2/ Cl_2/ Br_2)